**TALE - 2 Course Design and Instruction of Engineering Courses**

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**Lecture - 05**
**Analyze Phase 2**

Greetings and welcome to TALE Module 2 Unit 5. In the earlier unit we were looking at some sub-processes of Analyze Phase.

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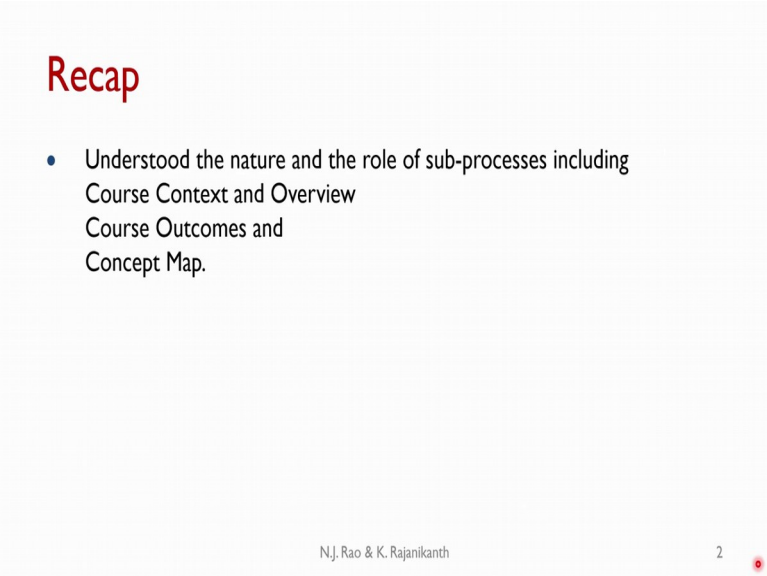


We were looking at the design of a course in the framework of ADDIE, and in the frame work of ADDIE, the first phase is . In Analyze phase the sub-processes that we followed can be made specific to your requirements. Our requirement is to design a course which is offered over a semester as a part of a four-year engineering program.

Among the sub-processes of Analyze phase we looked at the following three activities: course context and the overview, what is its role and how it should be written; writing the course outcomes which we have addressed in the Module 1 extensively; and also drawing a concept map.

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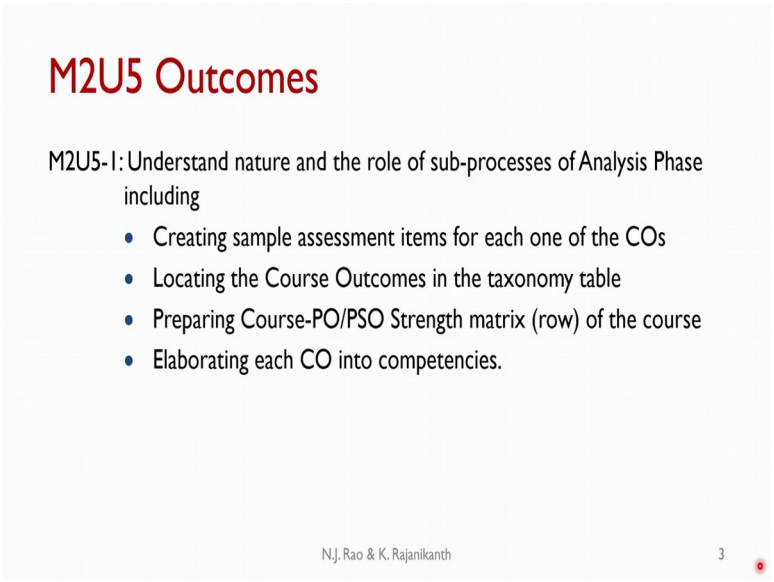


This Unit addresses Nature and role of other sub-processes of Analyze phase - once again in continuation of Unit 4. These sub processes are: creating sample assessment items for each one of the COs (we will presently elaborate on that); locating the course outcomes in the taxonomy table; preparing the course PO/PSO strength matrix; (strength matrix will actually be a row of the course); and elaborating each CO into competencies..

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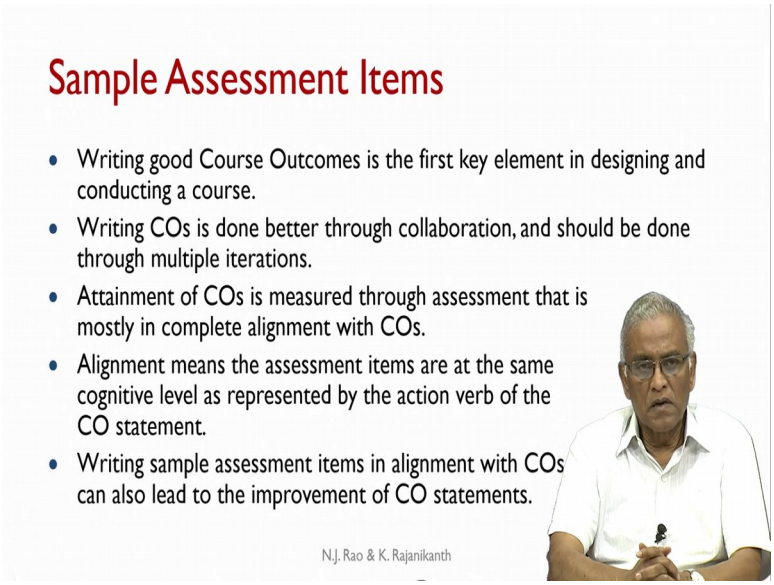

Writing good course outcomes is the first key element in designing and conducting a course. But this itself cannot be done just in a serial fashion. You need to do this iteratively. Writing COs is better done through collaboration.

We are also concerned with computing the attainment of COs. Attainment of COs is measured through assessment that needs to be in alignment with the CO. We have defined what is meant by alignment with an outcome. In the framework or context of a taxonomy table, the assessment and the CO should be in the same cell of the taxonomy table. Alignment also means the assessment items are at the same cognitive level as represented by the action verb of the CO statement.

Writing sample assessment items in alignment with COs can lead to the improvement of CO statements. When you first write COs, they may appear to be alright. We are required to conduct some assessment to find out whether the CO is attained or not. It means that the student should be able to perform some activity at the end of learning that particular CO.

They should be able to solve a set of problems at the end of instruction of that particular CO. What kind of problems should he solve? Those are the sample assessment items or sample problems that I need to create. Once I create those sample problems, I can look back at the CO and check for their alignment with each other. In the process I may iterate. For example, if my problems somehow not exactly representing the CO, I may be required to re-word the CO or I may have to design some additional sample problems to capture the CO that I have in mind.

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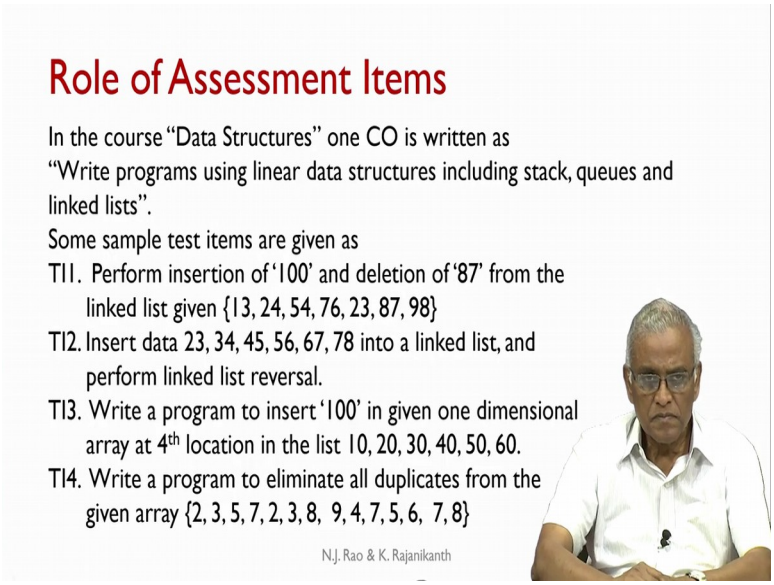


Let us look at an example. In the course on "data structures" a CO is written as "write programs using linear data structures including stack, queues and linked lists," which is an acceptable CO. "Write programs" would mean it belongs to apply activity, The items that are fully in alignment with CO should actually ask the student to perform some activity or write programs or do something related to these three data structures.

Here the sample test items given are:

- Perform insertion of '100' and deletion of '87' from the linked list given which is listed there;
- Insert data (those items) into the link list and perform link list reversal;
- Write a program to insert '100' in given one dimensional array at the 4th location in the list given;
- Write a program to eliminate all duplicates from the given array.

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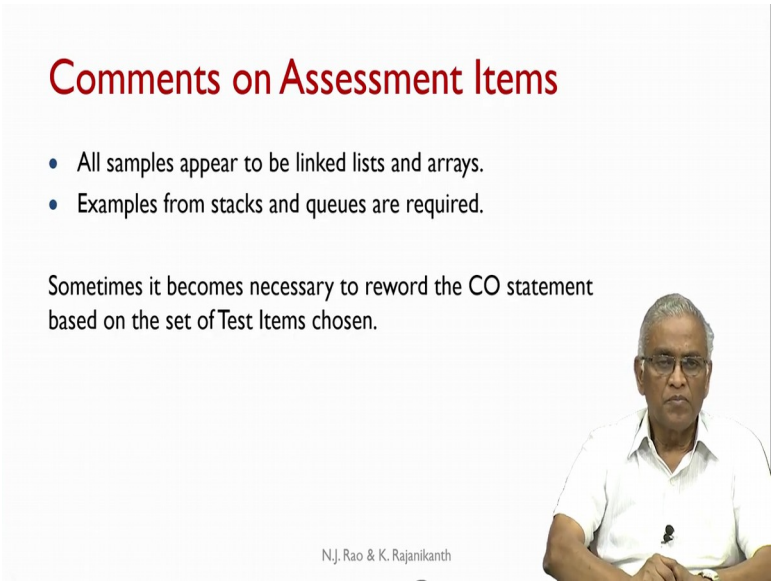


All sample problems that we have chosen appear to be linked lists or arrays. The other data structures stacks and queues are not addressed in the sample problems. When I give sample problems to the students, they will feel that the entire CO is only constrained to linked lists and arrays.

Hence, I need to either alter the CO. Either I remove the stacks and queues from the CO, or my sample problems should include problems related to stacks and queues.

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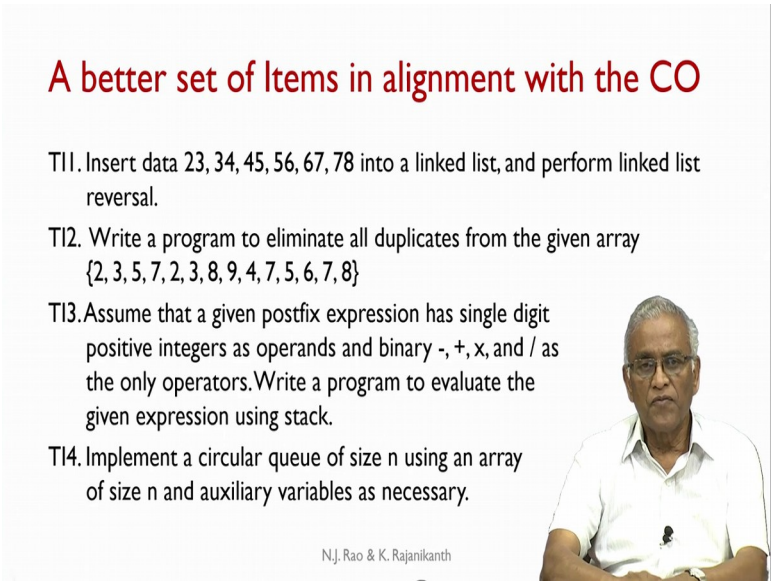

Here in this case, we find that there is no need to change the CO statement, but now I write a set of problems that represent all the four data structures that were mentioned in the CO statement. You have now problems like

- Write a program to evaluate the given expression using a stack?
- Implement a circular queue of size n using an array of size n and auxiliary variables as necessary.

We replaced two problems with the problems related to stack and queue. Please remember these are only sample problems. Why are they required? You should also include the sample answer along with the sample problems. By looking at the sample answer the students will be able to ascertain the kind of work required, the kind of prerequisite knowledge required. It will also help the teacher in planning the instruction. Writing a good set of sample test items is a prerequisite to actual instruction - one of the sub-processes in the Analyze phase.

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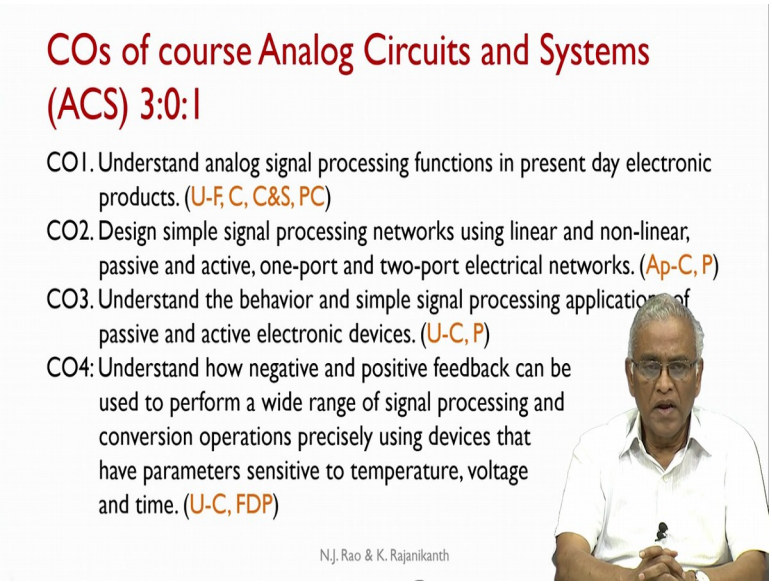


Locating the COs in taxonomy table: These are COs of a course on Analog Circuits and Systems. It is written for a 3:0:1 course, it can also be 4:0:1 depending on how the teacher wants it? One of the course outcomes is: CO3: Understand the behaviour of simple signal processing applications of passive and active electronic devices. When you look at it you can tag it with the cognitive level Understand-U, and it uses both conceptual and procedural knowledge.

It is tagged as U – C, P. If you look at CO4: Understand how negative and positive feedback can be used to perform a wide range of signal processing and conversion operations precisely using devices, that have parameters sensitive to temperature voltage and time.

We now tag it with "understand"; there are "concepts" and we put FDP that is Fundamental Design Principles. The very use of negative and positive feedback to influence the performance of an electronic circuit is a fundamental design principle that the students need to understand, hence the tag FDP.

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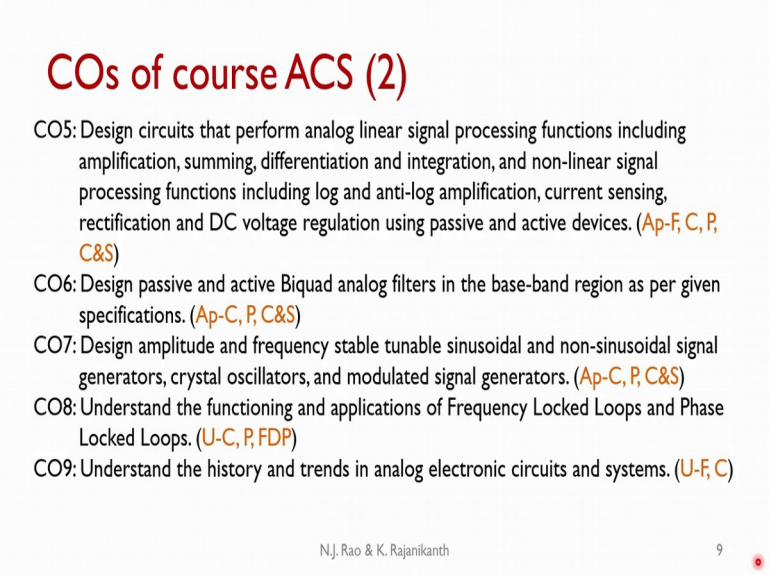


Similarly, the other COs of the same course (in total 9 of them) are all tagged correspondingly. CO6 is related to the major topic on filters - Design passive and active biquad analog filters in the base band region as per given specifications.

We have explained earlier that though we use the word design it belongs to apply; that means, the actual design of passive filter or active filter follows a well-defined process that was already communicated. The knowledge categories include conceptual (C), procedural (P) and C & S (criteria and specifications). We are tagging now with the cognitive levels and knowledge categories for all the COs.

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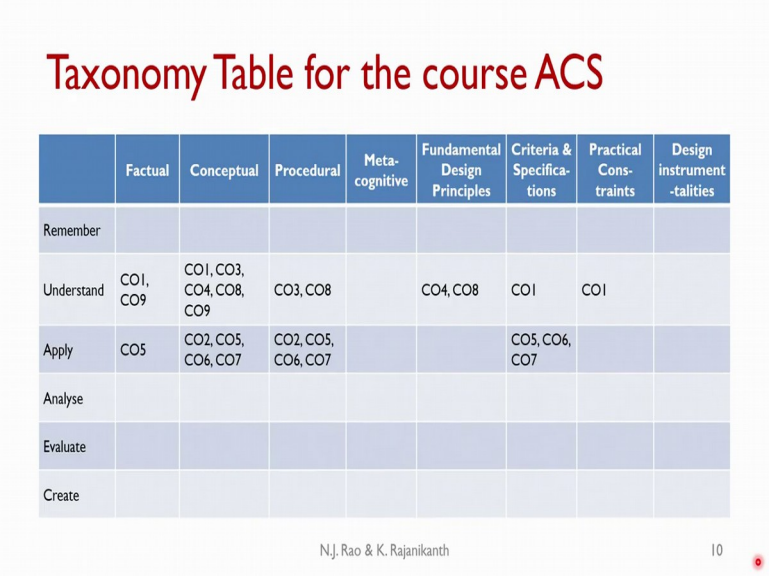


The COs can be located inside a taxonomy table. We have shown this earlier in the Module 1 as well. All the cognitive levels are shown as rows that is Remember, Understand, Apply and so on. On this we are showing the all the knowledge categories, and as you can see depending on the tagging that we located some COs in more than one column.

Take for example, CO2: it has conceptual as well as procedural knowledge elements. It will appear in two different cells. If you look at CO1 for example, it will appear in three cells: Factual Knowledge, Criteria and Specifications, and Practical Constraints. If you look at CO5, CO6, CO7 they will appear in the conceptual, apply; apply, procedural, and apply, criteria and specifications respectively.

By looking at the taxonomy table one may feel that if there is any particular cell that you want to address and you do not find in this, then it is a feedback to the course designer. It may be required to re-word or take a review of your course outcomes. This is a process of iteration. One of the tools that we use is locating COs in the taxonomy table. When we are designing assessments or when we are designing instruction, and it also need to located in the corresponding cell.

The taxonomy table really presents an artifact that allows you to look at the alignment between various activities, or whether we are addressing all the relevant knowledge categories or not. For example, here we are not addressing the metacognitive part, it does

not mean that metacognitive knowledge categories are unimportant; possibly we may or may not have the required knowledge and tools available to address that issue. But, any decision that you make, you should be aware of, and why you do not propose to address, say, the column of "metacognitive knowledge."

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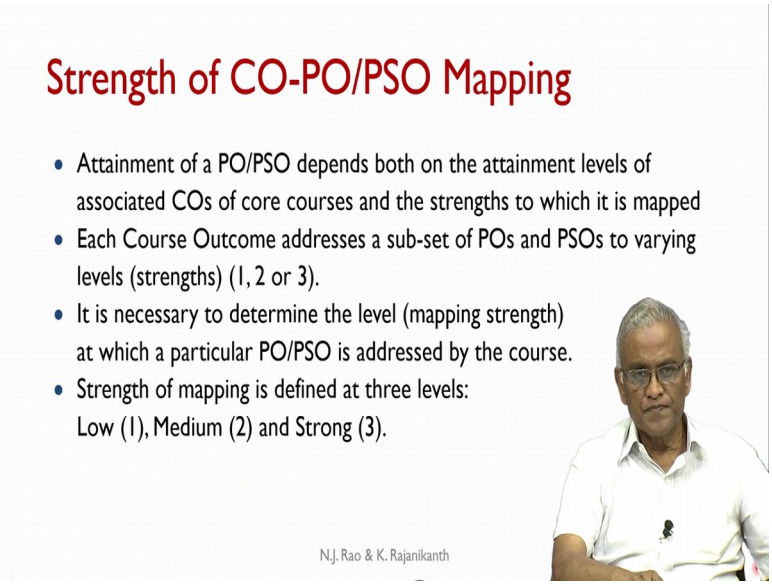


A program is characterized by Program Outcomes and Program Specific Outcomes. These POs and PSOs are mainly addressed or attained through core courses. There may be projects and some co-curricular and extracurricular activities beside core courses. But POs and PSOs need to be dominantly attained through formal core courses.

We need to compute to what extent POs and PSOs are attained. There are two issues; we tag our COs with POs and PSOs. But mere tagging by a PO and briefly mentioning in the classroom do I consider it adequately addressed?

We bring-in the concept of the strength to which a PO is mapped to a CO. (This we have considered extensively in Module 1.) Attainment of PO or PSO depends both on the attainment levels of associated COs and the strengths to which it is mapped. Each course outcome addresses a subset of POs and PSOs to varying levels.

Any course will only address a subset of POs and PSOs, and the strength is put as 1, 2 or 3, or you can say slightly, moderately, and significantly. Whatever wordings that you want to use you, identify three levels. One can use more levels, but then it becomes more

difficult to keep track of many levels. We need to find a simple but justifiable way of deciding the strength of addressing a PO from the course description through COs, and their tagging with POs, PSOs cognitive levels, knowledge categories and the number of sessions..

Strength of mapping is defined at 3 levels - low is 1; medium 2; strong is 3 or I can call it slightly, moderately and significantly.

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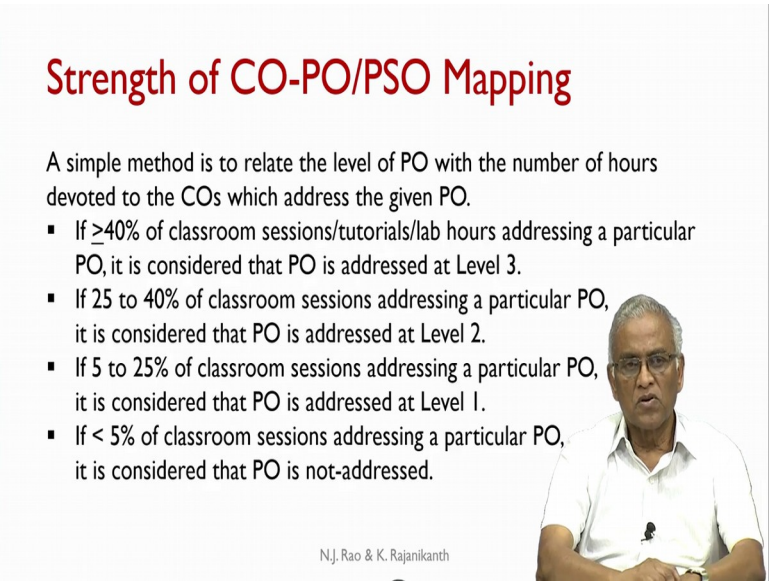


We gave a method the Module 1 to determine the strength of CO-PO/PSO Mapping. If an institute is not happy with this procedure they can redefine the procedure.

If more than 40% of classroom sessions or lab hours address a PO, it is considered that PO is addressed at level 3. For example, I differ with that I say unless it is greater than 60%, I do not consider it as level 3. Yes, the faculty of an institute should sit together and decide these percentages. If you do not want to follow this method at all, you can follow some other method, you are welcome to that, but it should be justifiable and can be used with respect to all the courses.

Here the strength of mapping we are defining is in terms of number of classroom sessions that we are taking. We use 0 if less than 5 percent of classroom sessions are used for addressing a particular PO. So, you have 0, 1, 2, 3 levels defined.

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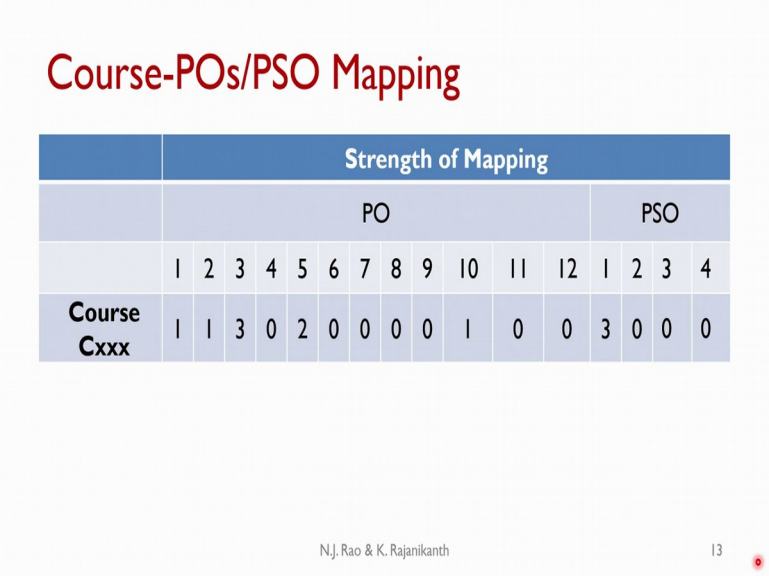


Mapping strength is captured like this. There are 12 POs and there can be 4 PSOs (it is 2 to 4 PSOs). We are taking a hypothetical course; based on classroom sessions taken for each CO and the tagging that we used, we came up with these numbers. That means, PO1 is addressed to the strength of 1, PO2 to 1, PO3 to 3, PO5 to 2, PO10 to 1 and PSO1 to 3. One may disagree with that, but then you have to re-word your course outcomes to modify these numbers.

It is very clear that this course is not addressing PO4, PO6, PO7, PO8, PO9, PO11 and PO12 as well and a PSO2, 3, 4 are also not addressed. Generally, this is the way a course would look; that means, you may have anywhere from 2 to 5 POs addressed to varying strengths, and possibly if your PSOs are written right, a course will address only one PSO. Depending on how you write, it may address some additional PSOs.

This is one of the steps that one needs to do as this information is carried forward to the later phases of course design, that is ,subsequent phases namely development, implement and evaluate.

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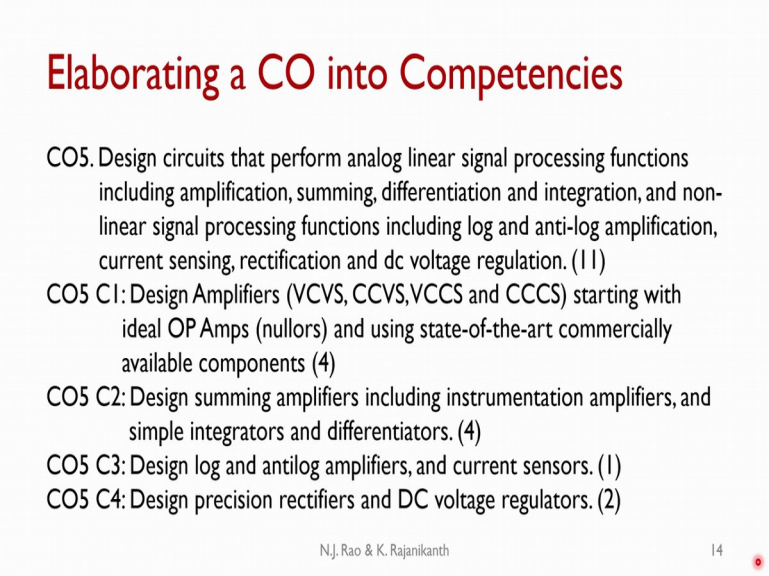


Let us look at another issue, another process in Analyze phase. Consider CO5 of the example course. Design circuits that perform analog linear signal processing functions including amplification, summing, differentiation and integration, and non-linear signal processing functions including log and antilog amplification, current sensing, rectification and DC voltage regulation. That is a CO written somewhat elaborately, because one can add or delete some of the items.

For example, a teacher may decide that I do not want to look at log and antilog amplification, because of the lack of time or I consider that at this level of the course, I do not need to address that. It was found that we will require about 11 classroom sessions. I have to partition the material and do some sequencing or introducing student based activities to facilitate students to get engaged with the knowledge. Planning 11 sessions as one unit can be tough.

As you can see from the very statement of CO5, I can break it into multiple outcomes, but next lower level outcomes. I need to give a name to that so, we call it officially competencies. Strictly speaking outcome and competency mean the same, but for our convenience we say CO5-C1 (Competency 1), CO5-Competency 2. We elaborate CO5 it into four different competencies.

The first unit of the CO5 becomes: Design amplifiers (VCVS, CCVS, VCCS and CCCS); starting with ideal OP-Amps and using state-of-the-art commercially available

components. Four classrooms sessions are required to perform this activity or to instruct this activity. It will also include student engagement that will come as a part of the instruction.

It is much more convenient to plan activities with smaller units like this. The first competency it requires 4 classroom sessions, second one 4 classroom sessions, third one only one, and fourth one requires 2. It also acts as a kind of feedback to the course designers. After breaking a CO into these Competencies, I may want to go back and reconsider the course outcome statement.

There are several iterations within each phase. Finally, we come with the proper set of course outcomes for this. So, what is the key output of Analyze phase? As far as formal engineering programs are concerned the primary output - the most significant output is the set of course outcome statements and elaborating these course outcome statements into competencies. The formal output of the Analyze phase get reviewed by peers.

When somebody outside looks at it, he may point out some missing things, or they may express opinions which will be very valuable inputs. The peer inputs are considered for any changes that you want to make COs. That is formative evaluation of Analyze phase outputs.

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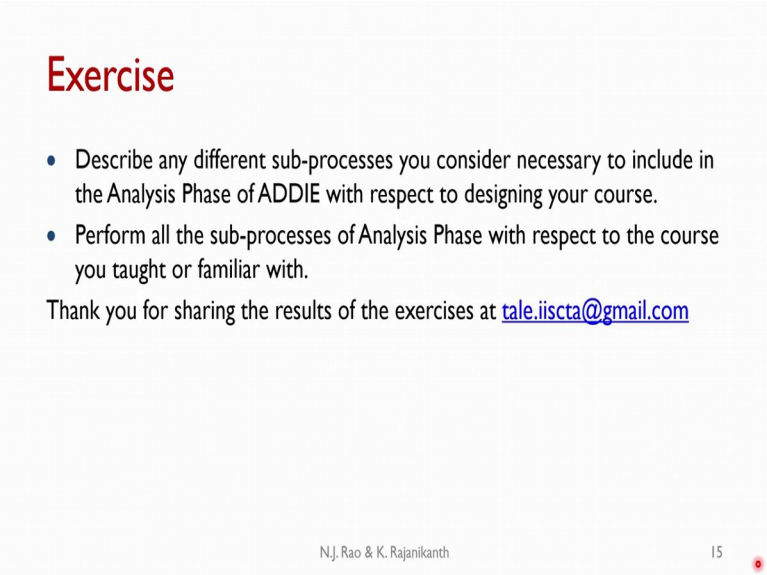

**Exercise**: Describe any different sub-processes you consider necessary to be included in the Analyze Phase of ADDIE with respect to designing your course. Because, we have given you 7 sub-processes in Analyze phase. What subprocesses need to be modified in your view and why?

The set can be made smaller or bigger based on your perception of the course. Each one of you have your own experiences with your own courses. You may suggest your additional processes or simplification of the sub-processes as presented here. Also, we suggest that you perform all the sub-process of Analyze phase with respect to the course you taught or familiar with. If you can share your output with us, it will become a very good source based on which we can interact with you more.

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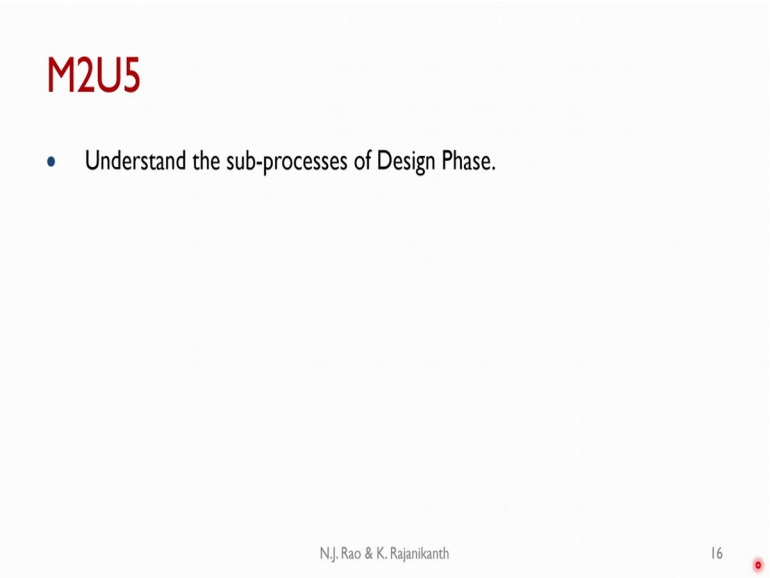


In the next unit M2 U6, we try to understand the sub processes of Design Phase.

Thank you very much for your attention.